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COMPARATIVE COSTS OF PRODUCING CONTAINER GROWN PLANTS IN OHIO DIFFERENTIATED BY SIZE OF FIRM AND SPECIES OF PLANT

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ABSTRACT

The objective of this study was to compare the costs of producing container grown plants in Ohio Differentiated by Size of Firm and Species of Plant. Total annual costs per salable plant in the small nursery by species were $4.50 for spreading evergreens (Juniperus), $5.04 for spreading deciduous shrubs (Cotoneaster), $5.58 for slow growing evergreens (Taxus), $5.84 for upright deciduous shrubs (Viburnum), and $7.36 for broadleaf evergreens (Rhododendron) averaging $5.46 across all species. For the large nursery, the comparable figures were $4.07 for spreading evergreens (Juniperus), $4.56 for spreading deciduous shrubs (Cotoneaster), $5.08 for slow growing evergreens (Taxus), $5.22 for upright deciduous shrubs (Viburnum), and $6.59 for broadleaf evergreens (Rhododendron), averaging $4.92 across all groups. Fixed costs accounted for over 90% and variable costs less than 10% of the cost differentials between the two sized nurseries. Cost differences between species was caused primarily by space requirements, cost of liners and overwintering needs.

INTRODUCTION

Nurserymen throughout the United States have been gradually shifting from field to container production for many species of plants. Containers allow greater flexibility in production and marketing and in most cases are less expensive than field production (1). Consequently, they have encouraged large companies to enter production and marketing. The result has been escalating competition and narrowing profit margins. Most nurserymen also lack the necessary expertise to systematically determine production costs. Due to increasing competition and periodically a slack economy many nursery operators find themselves in a precarious financial position. Survival under these conditions requires excellent production and marketing procedures. The purpose of this research was to provide nursery operators with production and financial information for decision making. This information should prove especially useful to individuals anticipating beginning a container nursery and to present field operators anticipating expanding to containers. It should also prove useful to present nurserymen with container operations who anticipate updating and expansion. Another value would be in identifying segments within present operations that might be providing bottlenecks which result in cost inefficiencies.

MATERIALS AND METHODS

In the study, two model firms were synthesized using the conceptual framework of economic engineering wherein the 'best proven practice' was included in each model (4). They were synthesized based on the Columbus, Ohio area. Data for this study were obtained from wholesale nurseries and nursery suppliers in Ohio during 1982.

The production system chosen consists of utilizing husky two or three year old bareroot liners to produce a salable plant within two growing seasons. These 6-7" liners are transplanted directly into two gallon (8-1/2" x 8") copolymer containers during the month of May. Approximately 10% of the crop will be sold during the fall of the second growing season (approximately 18 months), 50% during March and April after the second growing season (approximately 22-23 months), and 10% during May after the second growing season (24 months). May is a period when clean-up sales are being made and new plants started. This production system saves transplanting as the plants are sold in the same containers in which they are started (two gallon).

The nursery operations were assumed to produce a diverse line of nursery stock each having a two year production cycle. Commonly grown nursery stock was divided into five cultural groups. While not all inclusive, the groups do permit a range of per unit costs to be developed as they relate to input costs and cultural factors. For analytical purposes, it was assumed that each cultural group would occupy 20% of the growing area (i.e. small nursery = 68,000 sq ft per group; large nursery = 176,000 sq ft per group). The small container operation would be comprised of 198,745 units in full production and the large operation of 399,160 units. Annual sales capacity for the small operation would be 95,650 units and for the large operation 192,095 units. For detailed analysis, one specific plant from each group was chosen as representative of the group. While it is recognized that other plants from each category would have somewhat different requirements, it was felt that the requirements would not vary significantly in cost from the plant chosen as representative. The five groups, with some of their cultural characteristics are discussed in a companion article in this publication*

Costs were established for all factors of production including management and invested capital. Since most nurseries use cash rather than accural accounting procedures, the analyses were completed on a "cash" basis.

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*Annual Fixed Costs of Operating Container Nurseries in Ohio Differentiated by Size of Firm and Species of Plant.

Capital requirements for establishing the nurseries were first determined and were reported in a previous publication (2) Second, annual fixed costs were calculated and are report ed in a companion article in this publication*. Third, annual variable costs were calculated and added to fixed costs to determine annual total costs for the representative plant species for each sized nursery. An analysis of annual costs of producing Juniperus chinensis 'Pfitzeriana' was previously reported (3) . Annual costs of producing plants in the other four plant groups are reported in companion articles in this publication.** Fifth, summaries were made for annual fixed, variable and total costs for each of the selected species according to size of nursery (Tables 1 thru 4).

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*Annual Fixed Costs of Operating Container Nurseries in Ohio Differentiated by Size of Firm and Species of Plant.

**Annual Costs of Producing Spreading Deciduous Shrubs (Cotoneaster) Differentiated by Size of Firm in Ohio.

Annual Costs of Producing Slow Growing Evergreens (Taxus) Differentiated by Size of Firm in Ohio.

Annual Costs of Producing Upright Deciduous Shrubs (Viburnum) Differentiated by Size of Firm in Ohio.

Annual Costs of Producing Broadleaf Evergreens (Rhododendron) Differentiated by Size of Firm in Ohio.

RESULTS AND DISCUSSION

Annual fixed costs associated with capital investment including depreciation, interest, insurance and taxes were $139,680 per year for the small nursery. In addition there was $95,025 allocated for general overhead and $7,885 for interest on general overhead, insurance and taxes making a total of $242,590 total fixed costs for the small nursery (Table 1). These costs were divided equally between the five plant groups with each group receiving an assesment of $48,517 (Table 1). It was felt that the most reasonable way of assigning fixed cost is by area rather than plant. Once the physical facility is provided, fixed costs are incurred at essentially the same amount regardless of how the nursery facility is used. On a per-salable-plant basis, there was a considerable difference in annual fixed costs when they were differentiated by plant group (Table 3). In the small nursery, they were: $1.90 for group I (Juniperus), $2.34 for group II (Cotoneaster), $2.42 for group III (Taxus), $3.00 for group IV (Viburnum), and $3.72 for group V (Rhododendron). The average over all groups was $2.53. Annual fixed costs for group V were more than double those for group I. These costs were proportionate to the number of salable plants per annum produced in allocated space. Fixed costs as a percentage of total costs ranged from 42% to 51% in the small nursery averaging 46% across the five groups (Table 3).

For the large nursery, annual fixed costs associated with capital investment; depreciation, interest, insurance and taxes were $228,526. An additional $150,000 was allocated for general overhead and $12,521 for interest on general overhead, insurance, and taxes making a total of $391,047 annual fixed costs for the large nursery (Table 2). Assessment per plant group was $78,209 (Table 2). Annual fixed costs per-salable-plant were: $1.50 for group I, $1.89 for group II, $1.95 for group III, $2.42 for group IV, and $3.00 for group V averaging $2.04 over all groups (Table 4). Fixed costs as a percent of total costs were lower than for the small nursery ranging from 37% to 46% averaging 42% across groups (Table 4). This lower percentage was associated with the lower capital requirement per salable plant capacity.

Annual fixed costs per-salable-plant were substantially lower for the larger nursery compared to the smaller. For group I the difference was $0.40, for group II, $0.45, for group III, $0.47, for group IV, $0.58 and for group V, $0.72 averaging $0.49 accross groups. This approximate 25% gain in efficiency when going from the small to the large nursery is once again attributable to the more efficient use of buildings, machinery, and equipment of the large nursery over the small.

Nurserymen having established facilities might well consider annual fixed costs to be lower than those reported here. This is especially true if they compute depreciation and repairs on the original value of land improvements, buildings, machinery and equipment and if they place a low value on their own management input. Good management, for planning purposes, however, dictates computing depreciation and repairs on replacement value rather than cost. It also dictates placing a value on managerial time that would be comparable to salaries paid in competitive firms.

Total variable costs for the small nursery by plant group were $66,580 for group I (Juniperus), $56,007 for group II (Cotoneaster), $63,536 for group III (Taxus), $46,033 for group IV (Viburnum), and $47,501 for group V (Rhododendron). Total for all groups was $279,657 (Table 1). The difference in total annual variable costs between groups is primarily accounted for by the number of plants in the group. The fewer the plants, the fewer the containers, soil mixture, liners, labor to move containers, etc. On a per-salable-plant basis, the groups practically reversed themselves (Table 3). Annual variable costs by plant were $2.60 for group I, $2.70 for group II, $3.16 for group III, $2.84 for group IV, and $3.64 for group V averaging $2.93 across groups. In groups with fewer plants, greater costs were incurred on a per plant basis for polyethylene film, chemicals, machinery, equipment, and labor. Other variable costs that varied substantially between groups were the cost of liners and for groups II (Cotoneaster) and V (Rhododendron) the addition of thermal blankets for overwintering protection. Variable costs for the small nursery ranged from 49% to 58% of total costs averaging 54% across groups (Table 3).

For the large nursery, variable costs by plant group were $211,423 for Group I, $189,005 for group II, $204,128 for group III, $169,124 for group IV, and $172,053 for group V. Total for all groups was $945,733 (Table 2). On a per-salable-plant basis they were $2.57 for group I, $2.67 for group II, $3.13 for group III, $2.80 for group IV, and $3.60 for group V averaging $2.88 across all groups (Table 4). Variable costs for the large nursery ranged from 54% to 63% of total costs averaging 58% across all groups.

While fixed cost differentials between size of nursery were substantial, this was not the case with variable costs. The difference for groups I, II, and III was $0.03 and for groups IV and V $0.04.

Total annual costs are the summation of fixed and variable. For the small nursery they were $115,097 for group I (Juniperus), $104,524 for group II (Cotoneaster), $112,053

for group III (Taxus), $94,550 for group IV (Viburnum), and $96,018 for group V (Rhododendron). For all groups they totaled $522,242 (Table 1). On a per-salable-plant basis they were $4.50 for group I, $5.04 for group II, $5.58 for group III, $5.84 for group IV, and $7.36 for group V averaging $5.46 across groups (Table 3).

Total annual costs for the large nursery were $211,423 for group I, $189,005 for group II, $204,128 for group III, $169,124 for group IV, and $172,053 for group V. They totaled $945,733 for all groups (Table 2). On a per-salable-plant basis they were $4.07 for group I, $4.56 for group II, $5.08 for group III, $5.22 for group IV, and $6.59 for group V averaging $4.92 across all groups (Table 4).

Differences in total annual costs per salable plant between the two sized nurseries were $0.43 for group I, $0.48 for group II, $0.50 for group III, $0.62 for group IV, and $0.77 for group V averaging $0.54 across all groups. It is important to note that of the total differential, all but three or four cents per group was caused by fixed costs. This means that fixed costs accounted for over 90% and variable costs less than 10% of the cost differentials per-salable-plant between the two sized nurseries. For nurseries of the sizes annalyzed, economies of size are achieved in fixed rather than variable costs. Variable costs presented should be quite representative for zone six nurseries doing a good job of management

SUMMARY AND IMPLICATIONS

Large sized commercial container nurseries are able to make more efficient use of buildings, equipment, and machinery than small container nurseries. This results in large nurseries having a lower cost per salable plant. Most commercial nurseries are similar in efficiency factors relative to growing space.

Total annual costs per salable plant in the small nursery differentiated by species ranged from $4.50 to $7.36 averaging $5.46 across species. In the large nursery comparable values were $4.07, $6.59, and $4.92. Over 90% of the differential noted between the two sized nurseries can be attributed to fixed costs.

Fixed costs per salable plant in the small nursery ranged from $1.90 to $3.72 averaging $2.53. In the large nursery comparable costs were $1.50, $3.00, and $2.04. This approximate 25% gain in efficiency when going from the small to the large nursery is attributable to the more efficient use of buildings, machinery, and equipment of the large nursery over the small. Fixed costs as a percentage of total costs in the small nursery ranged from 42% to 51% averaging 46% across species. Comparable values for the large nursery were 37%, 46%, and 42%. Differences in fixed costs between plant species were totally determined by space requirements for production.

Variable costs per salable plant showed substantial differences between plant species, but were only slightly affected by size of nursery. In the small nursery they ranged from $2.60 to $3.64 averaging $2.93 across species. Comparable figures for the large nursery were $2.57, $3.60, and $2.88. Major differences between species affecting variable costs were spacing requirements, cost of liners and overwintering requirements. Variable costs between the two sized nurseries by species ranged from three to four cents per salable plant. Variable costs as a percentage of total costs in the small nursery ranged from 49% to 58% averaging 54%. Comparable values for the large nursery were 54%, 63% and 58%.

These figures demonstrated that variable costs per salable plant, while having wide variations between species, remain reasonably constant when comparisons are made between the two sized nurseries. The small nursery could purchase materials and other variable items almost as cheaply as could the large. Fixed costs in contrast changed significantly as size of nursery increased. This occurred because most of the fixed factors required to operate the small nursery such as management, buildings, and most machinery and equipment were

also adequate to operate the large. As the size of nursery increased, costs for fixed items of production were spread over more salable units, thereby reducing the fixed cost per plant.

Implications

A comparison of total annual costs of producing plants with prices in Ohio producers' wholesale catalogs would undoubtedly show, in a great many cases, selling prices lower than total annual costs. In fact, if one were to add costs of selling, very few producers would presently be charging enough to cover all costs let alone profits. How then can producers continue to operate? The answer lies in how producers both experience and figure costs. We have used the economic or accounting method which includes both explicit and implicit costs. Explicit costs are those that are paid directly and easily determined, e.g. cost of liners, soil media, fertilizers, labor, etc. Implicit costs are those that are more difficult to determine such as the cost of equity capital and managerial capacities. The way these costs are determined vary significantly from firm to firm. Well established nurseries are usually very accurate in determining explicit costs, but often do not consider all implicit costs. They base their costs on "cash flow" and profit and loss on "tax accounting". These established nurseries, having purchased land at low cost, working with depreciated equipment and often assigning low if any value to their management would determine their costs at a much lower level than presented in this article. Also, careful site selection could significantly reduce fixed (overhead) costs. However, if one were to start a new container nursery, in a "normal" Ohio site, costs would probably be very close to those presented here.

For the industry, selling nursery products for below "accounting costs" implys that well-established nurseries, operating essentially debt free, would have strong staying power whereas those who have just started or are heavily in debt may not be able to survive, especially if they are relying on their container operation to meet all overhead expenses. Second, starting a container nursery in Ohio would probably not prove profitable unless items like buildings, equipment, machinery, management, etc., could be shared with other enterprises or unless selling prices of nursery products in the zone increasd substantially. At current prices for nursery products, this study shows that the return on investment for establishing new, independently operating, container nurseries in Ohio would be marginal if not negative.

LITERATURE CITED

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TABLE 1.--Summary of Annual Fixed, Variable and Total Costs (Dollars) of Operating a Small* Container Nursery in Ohio, 1982

Item	Group I (Juniper)	Group II (Contoneaster)	Group III (Taxus)	Group IV (Viburnum)	Group V (Rhododendron)	Total
Fixed Cost						
Land and improvements	8,616	8,616	8,616	8,616	8,616	43,080
Buildings	10,190	10,190	10,190	10,190	10,190	50,950
Machinery and equipment	9,129	9,129	9,129	9,129	9,129	45,645
General overhead	19,005	19,005	19,005	19,005	19,005	95,025
Interest on general overhead, insurance, and taxes	1,577	1,577	1,577	1,577	1,577	7,885
Subtotal	48,517	48,517	48,517	48,517	48,517	242,585
Variable Costs						
Materials	45,631	38,268	45,095	30,818	33,113	192,925
Machinery and equipment	3,675	3,675	3,675	3,675	3,675	18,375
Labor	12,633	10,024	10,341	8,333	7,266	48,597
Interest on operating capital	4,641	4,040	4,425	3,207	3,447	19,760
Subtotal	66,580	56,007	63,536	46,033	47,501	279,657
TOTAL	115,097	104,524	112,053	94,550	96,018	522,242
Salable Plants per Year	25,600	20,730	20,085	16,185	13,050	95,650
Annual Cost per Salable Plant	4.50	5.04	5.58	5.84	7.36	5.46

*17.04 Acres, 340,000 sq ft of growing space, 204,000 sq ft of polyhouse space

TABLE 2.--Summary of Annual Fixed, Variable and Total Costs (Dollars) of Operating a Larger Container Nursery in Ohio, 1982

Item	Group I (Juniper)	Group II (Contoneaster)	Group III (Taxus)	Group IV (Viburnum)	Group V (Rhododendron)	Total
Fixed Cost						
Land and improvements	16,436	16,436	16,436	16,436	16,436	82,180
Buildings	16,127	16,127	16,127	16,127	16,127	80,635
Machinery and equipment	13,142	13,142	13,142	13,142	13,142	65,710
General overhead	30,000	30,000	30,000	30,000	30,000	150,000
Interest on general overhead, insurance, and taxes	2,504	2,504	2,504	2,405	2,504	12,520
Subtotal	78,209	78,209	78,209	78,209	78,209	391,045
Variable Costs						
Materials	92,649	76,465	90,185	61,644	66,226	387,169
Machinery and equipment	6,282	6,282	6,282	6,282	6,282	31,410
Labor	24,998	20,054	20,676	16,655	14,524	96,907
Interest on operating capital	9,285	7,995	8,776	6,334	6,812	39,202
Subtotal	133,214	110,796	125,919	90,915	93,844	554,688
TOTAL	211,423	189,005	204,128	169,124	172,053	945,733
Salable Plants per Year	52,000	41,455	40,165	32,380	26,095	192,095
Annual Cost per Salable Plant	4.07	4.56	5.08	5.22	6.59	4.92

*33.04 acres, 680,000 sq ft of growing space, 408,000 sq ft of polyhouse space

TABLE 3.--Summary of Annual Fixed, Variable, and Total Costs (Dollars) per Salable Plant of Operating a Small Container Nursery in Ohio, 1982.

Item	Group I (Juniper)		Group II (Cotoneaster)		Group III (Taxus)		Group IV (Viburnum)		Group V (Rhododendron)		Average	
	Cost per Saleable Plant	Percent of Total Cost	Cost per Saleable Plant	Percent of Total Cost	Cost per Saleable Plant	Percent of Total Cost	Cost per Saleable Plant	Percent of Total Cost	Cost per Saleable Plant	Percent of Total Cost	Cost per Saleable Plant	Percent of Total Cost
Fixed Cost Items												
Land and Improvements	.34	(8)	.41	(8)	.43	(8)	.53	(9)	.66	(9)	.45	(8)
Buildings	.40	(9)	.49	(10)	.51	(9)	.63	(11)	.78	(11)	.53	(10)
Machinery and Equipment	.36	(8)	.44	(8)	.45	(8)	.56	(9)	.70	(9)	.48	(9)
General Overhead	.74	(16)	.92	(18)	.95	(17)	1.18	(20)	1.46	(20)	.99	(18)
Interest on General Overhead, Insurance, and Taxes	.06	(1)	.08	(2)	.08	(1)	.10	(2)	.12	(2)	.08	(1)
Subtotal	1.90	(42)	2.34	(46)	2.42	(43)	3.00	(51)	3.72	(51)	2.53	(46)
Variable Cost Items												
Materials	1.78	(40)	1.85	(37)	2.24	(40)	1.90	(33)	2.54	(35)	2.02	(37)
Machinery and Equipment	.15	(3)	.18	(4)	.18	(3)	.23	(4)	.28	(4)	.19	(4)
Labor	.49	(11)	.48	(9)	.52	(10)	51	(9)	56	(7)	.5[illegible]	(9)
Interest on Operating Capital	.18	(4)	.19	(4)	.22	(4)	.20	(3)	.26	(3)	.21	(4)
Subtotal	2.60	(58)	2.70	(54)	3.16	(57)	2.84	(49)	3.64	(49)	2.9[illegible]	(54)
Total Annual costs	4.50	(100)	5.04	(100)	5.58	(100)	5.84	(100)	[illegible]56	(100)	5.46	(100)

*17.04 acres, 340,000 sq ft of growing space , 204,000 sq ft of polyhouse space

TABLE 4.--Summary of Annual Fixed, Variable, and Total Costs (Dollars) per Saleable Plant of Operating a Large Container Nursery in Ohio, 1982

Item	Group I (Juniper)		Group II (Cotoneaster)		Group III (Taxus)		Group IV (Viburnum)		Group V (Rhododendron)		Average	
	Cost per Saleable Plant	Percent of Total Cost	Cost per Saleable Plant	Percent of Total Cost	Cost per Saleable Plant	Percent of Total Cost	Cost per Saleable Plant	Percent of Total Cost	Cost per Saleable Plant	Percent of Total Cost	Cost per Saleable Plant	Percent of Total Cost
Fixed Cost Items												
Land and Improvements	.31	(8)	.40	(9)	.41	(8)	.51	(10)	.63	(10)	.43	(9)
Buildings	.31	(8)	.39	(9)	.40	(8)	.50	(9)	.62	(9)	.42	(9)
Machinery and Equipment	.25	(6)	.32	(7)	.33	(6)	.41	(8)	.50	(8)	.34	(7)
General Overhead	.58	(14)	.72	(16)	.75	(15)	.92	18)	1.15	'17	.78	16)
Interest on General Overhead, Insurance, and Taxes	.05	(1)	.06	(1)	.06	(1)	.08	(1)	.10	(2)	.07	(1)
Subtotal	1.50	(37)	1.89	(42)	1.95	(38)	2.42	(46)	3.00	(46)	2.04	(42)
Variable Cost Items												
Materials	1.79	(44)	1.85	(41)	2.24	(44)	1.90	(36)	2.54	(39)	2.01	(41)
Machinery and Equipment	.12	(3)	.15	(3)	.16	(3)	.19	(4)	.24	(3)	.16	(3)
Labor	.48	(12)	.48	(10)	.51	(10)	.51	(10)	.56	(8)	.51	(10)
Interest on Operating Capital	.18	(4)	.19	(4)	.22	(5)	.20	(4)	.26	(4)	.20	(4)
Subtotal	2.57	(63)	2.67	(58)	3.13	(62)	2.80	(54)	3.60	(54)	2.88	(58)
Total Annual costs	4.07	(100)	4.56	(100)	5.08	(100)	5.22	(100)	6.59	(100)	4.92	(100)

*33.04 acres, 680,000 sq ft of growing space , 408,000 sq ft of polyhouse space.